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Case Report

Retrograde Use of Frontrunner Catheter in Superficial Femoral Artery for Flushing Long Segment Occlusions Involving Distal Common Femoral Artery

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We present the case of an 81-year-old female with flush occlusion of the superficial femoral artery (SFA) and percutaneous transluminal angioplasty. Initially, the antegrade approach failed due to flush occlusion without stump. Hard, round surfaced, calcific, and eccentric plaque of the ostium of SFA was also present, which involved distal common femoral artery (CFA). Thus, we successfully used a Frontrunner catheter for retrograde reentry at the lower position of the CFA. Various treatment strategies involving Frontrunner and atherectomy devices could make percutaneous procedures possible in femoropopliteal occlusive disease, involving the CFA.

Keywords: atherectomy, common femoral artery, Frontrunner device, femoropopliteal disease

Introduction

Femoropopliteal (FP) involvement in occlusive peripheral arterial disease (PAD) is common and previously reported to be found in up to 50% of all symptomatic patients undergoing angiography.[1)] With highly developed devices and interventional techniques, success rate of FP intervention has improved. Although the recently developed drug-coated balloon (DCB) has made peripheral transluminal angioplasty (PTA) available for flexion site intervention without long stent implantation,[2)] chronic long segment total occlusion (CTO) involving this site is still challenging, particularly when the proximal cap is flush occluded and heavily calcified. When there is no stump at the common femoral artery (CFA) toward the occluded superficial femoral artery (SFA), antegrade techniques with dedicated CTO devices or wire escalation with varying support catheters, often yield low success rates and jeopardize the adjacent deep femoral and common femoral arteries. A Frontrunner device was then introduced to facilitate hard calcific plaque disruption by making microdissection for PAD. This method successfully revascularized the patient using a retrograde approach, with a dedicated intraluminal Frontrunner CTO crossing device catheter.

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Case Review

An 81-year-old female patient visited our hospital due to right leg pain during rest (Rutherford IV). Her comorbidities included hypertension, chronic renal insufficiency, and coronary artery disease. An angiogram performed via the left CFA access revealed a 20-cm long occlusion of the right SFA without stump (**Fig. 1A**) with atherosclerotic stenosis at the distal SFA (**Fig. 1B**). A 6 French Pinnacle Destination Sheath (Terumo Interventional Systems, Somerset, NJ, USA) was placed contralaterally and a 0.035″ angled hydrophilic guidewire (Glide, Terumo Interventional Systems) with the support of a Quick-Cross catheter (The Spectranetics Corp., Colorado Springs, CO, USA) was obtruding the occlusion site. Then, the repeated antegrade wire penetrations were tried with various escalating guidewires and support catheter systems. Initial attempts in an antegrade manner proved unsuccessful due to the convex, round surface of the calcified distal CFA plaque, causing complete occlusion of the ostial SFA. This would divert devices and wires into the deep femoral artery. Since digital subtraction angiography (DSA) demonstrated a patency of 3 below the knee arteries with good runs of 2-mm sized posterior tibial artery in the medial malleolar area, a retrograde transpedal approach with access to the posterior tibial artery was used to recanalize the chronic long SFA occlusion from below. Following the introduction of a 4-French sheath (Slender, Terumo Interventional Systems), an angled glide guidewire with the support of a Quick-Cross catheter was pushed through to the reconstituted distal segment of the SFA. Due to the ambiguity of the vessel course, a knuckle wire technique was successfully

employed, and the wire and catheter were nearly pushed all the way through the occluded parts up to the ostium of the SFA, subintimally (**Fig. 2A**). For without making large dissection at the flexion site, we aimed to maintain the reentry position as low as possible. Using DSA with dual injections on both sides of the occlusion (**Fig. 2B**, arrow), round calcified proximal plaque was identified at the bifurcation of the CFA, extending to the ostial SFA which caused a total occlusion. The eccentric plaque again did not allow the wire to enter the true lumen of the CFA, not even retrogressively. To mechanically disrupt the calcified cap of the ostial SFA and adjacent plaque in the distal CFA, the Frontrunner XP CTO (Cordis Corp., Miami Lakes, FL, USA) was utilized retrogressively. The plaque should preferably be disrupted through blunt microdissection, while still maintaining the integrity of the CFA without perforation. When the Frontrunner was introduced retrogressively, the ostial cap and adjacent plaque were successfully penetrated (**Fig. 2C**), and then 0.035″ angled glide wire was successfully pushed across the calcified ostium into the true lumen of the CFA (**Fig. 2D**). Once successfully crossing the wire, the retrogressive wire was externalized through the anterogressive sheath (**Fig. 2E**). Because of the calcified plaque in the distal CFA into the ostial SFA, the optimal plaque modification with atheterectomy was performed using a 2-mm classic crown Diamondback 360 Peripheral Orbital Atherectomy System (Cardiovascular Systems Inc., St. Paul, MN, USA; **Fig. 3A**, arrow). Conventional balloon angioplasty was then performed with 6×40 mm balloon (Armada, Abbott, Abbott Park, IL,

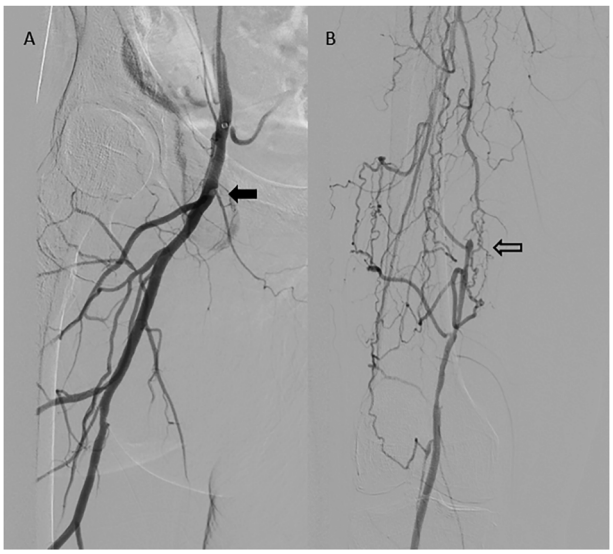

Fig. 1 A digital subtraction angiography indicated total occlusion of the superficial femoral artery. (**A**) Angiography shows stumpless occlusion of the superficial femoral artery. Arrow indicates eccentric atherosclerotic plaque filling inside the common femoral artery. (**B**) Delayed angiography shows long occlusion with reconstitution at the distal superficial femoral artery (open arrow).

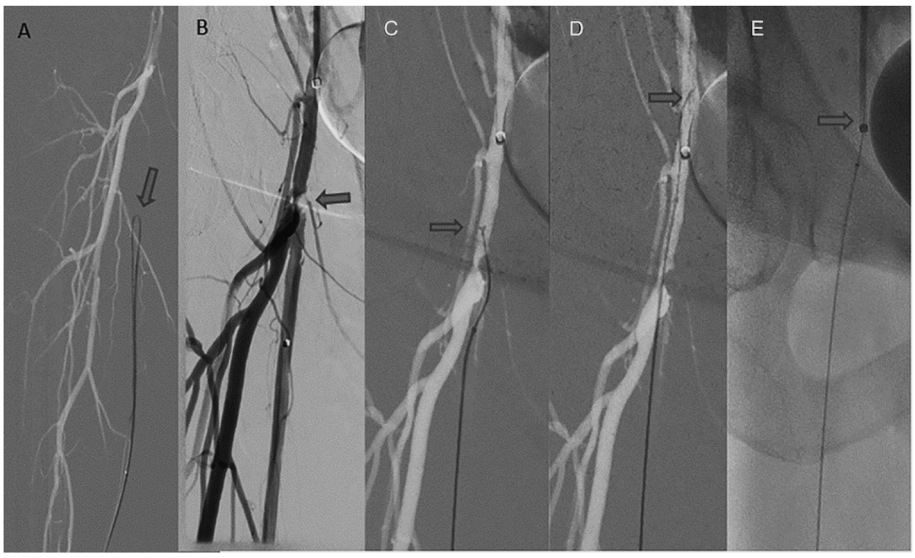

Fig. 2 The images demonstrated serial process of retrogressive wire penetration. (**A**) A 0.035″ guidewire was retrogressively pushed through the occluded artery making a loop (arrow; Knuckle wire technique). (**B**) A bidirectional sheath angiography indicated occlusion at the ostial superficial femoral artery. Arrow indicates the eccentric plaque interrupting the flow at common femoral artery. (**C**) A Frontrunner catheter (arrow) penetrates into the lumen from the subintimal space at the common femoral artery. (**D**) A guidewire (arrow) with the support catheter successfully introduced into the lumen of the external iliac artery. (**E**) A wire from pedal access is pushed into the sheath (arrow) from contralateral side.

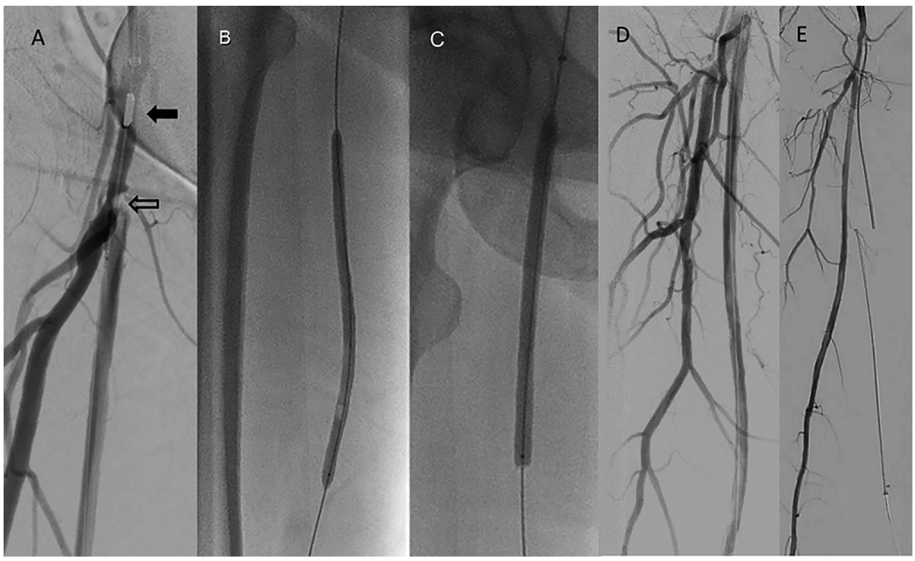

Fig. 3 Angiographic images demonstrate the atherectomy, balloon angioplasty, and final result of the procedure. (**A**) A 2-mm sized crown of the atherectomy device system is used (arrow) to bypass eccentric plaque at the common femoral artery (open arrow). (**B**) A 5×150 mm drug-coated balloon is inflated in the occluded site at proximal to mid superficial femoral artery. (**C**) A 6×100 mm drug-coated balloon is inflated from the ostial superficial femoral artery. (**D**) Final angiography shows patent distal flow in the entire superficial femoral artery. A plaque at the common femoral artery is disappeared after atherectomy and balloon angioplasty. (**E**) Angiography taken 2 months after the index procedure shows good distal flow without having restenosis anywhere in the SFA. SFA: superficial femoral artery

USA) resulting in impressive luminal gain throughout the entire lesion from the distal CFA to the distal SFA. The same length of the lesion was ultimately treated with multiple DCB angioplasty (5×150 mm and 6×100 mm, Bard Lutonix, New Hope, MN, USA; **Figs. 3B** and **3C**). The final DSA showed excellent angiographic outcome without the extension of dissection above the occluded vessel (**Fig. 3D**). Good angiographic result was shown 2 months after the index procedure (**Fig. 3E**), and a Doppler ultrasonography demonstrated patent flow through the entire segment of the treated vessel after 7 months.

Discussion

This technique of utilizing the Frontrunner catheter retrogressively enabled us to meticulously penetrate the ostial cap without disrupting the adjacent CFA or deep femoral arteries. Similar strategies have been employed using the Frontrunner catheter to revascularize CTO of the long SFA anterogressively by ipsilateral antegrade puncture, thanks to a sufficient proximal SFA stump.[3] Our case, however, proved particularly challenging because of the lack of stump, flush ostial occlusion, and the presence of a heavily calcified plaque, adjacent to the ostial SFA involving the distal CFA.

Various devices and techniques for PTA are now available and they have efficiently and safely broadened the percutaneous treatment field. Success rate now always exceed 90% even in TASC D or long occlusive disease subset, which traditionally was not recommended to be treated by PTA.[4] The subintimal approach accompanied by the development of reentry device from various vascular accesses has particularly made the success rate higher than before.[5,6]

The Frontrunner CTO catheter was introduced to make intraluminal blunt microdissection for the recanalization of CTO. This device has jaws which can disrupt the plaque, thereby creating an intraluminal passage through the occlusion for the guidewire. Earlier report indicated success rates of 91% of the 44 CTO in PAD patients (approximately 43% of the cases of this study was FP disease)[7] and 95.5% in the 22 FP occlusive disease patients.[8] The embolization risk of the deep femoral artery from the Frontrunner catheter in this particular position of the CFA is low because plaque volume was relatively small and the workings of the device was to make microdissections to penetrate the lumen, rather than tearing off the plaque. Furthermore, the device was cautiously maneuvered.

Our technique uniquely utilized the Frontrunner catheter to retrogressively recanalize the long segment SFA CTO to avoid any vascular damage in the CFA. No stump in the CFA toward the SFA made anterograde approach inappropriate. A pedal access rather than the distal SFA or popliteal artery seemed to be a better option for this elderly patient,

as it provided convenience with the supine procedure.[9] Moreover, the atherosclerotic stenosis was extended to the distal part of the SFA in this patient. The small profile of the Frontrunner catheter (0.76–1 mm of diameter, 2.8 French distal tip) makes it optimal for pedal access introduction. The technique of transpedal access in our case was possible due to a posterior tibial vessel diameter of >1.5 mm by quantitative angiography and ultrasound guidance.

The use of atherectomy devices could be a good strategy of target lesion revascularization reduction in the CFA,[10] combined with DCB, without putting a stent in a joint area.[11] It also showed good 12 months outcome result in heavy calcified arterial disease.[12] To achieve sufficient plaque modification and optimal balloon angioplasty effect, rotation atherectomy at the CFA toward the ostial SFA was utilized. This was for the calcified, eccentric plaque before the balloon angioplasty. Consequently, the final angiographic result combined with the rotation atherectomy and balloon angioplasty was satisfactory without putting additional stent in the CFA or SFA. The unique angiographic feature of this long SFA occlusion is a good balloon angioplasty, which results in the remaining entire SFA. The ostial SFA's hard calcified plaque was assumed to have caused the flow limitation and induced occlusion of the entire SFA. Uniquely challenging to our case was the smooth surface of the ostial SFA cap involving the distal CFA, which would divert devices into the deep femoral artery. A retrograde strategy with the advent of newer CTO crossing devices in such cases has the potential role of facilitating recanalization. As such, devices are often limited by size requirements; the small profile of the Frontrunner catheter makes it optimal for pedal access introduction.

Conclusion

A Frontrunner device can be used to retrogradely penetrate the hard proximal cap of a long occluded segment of the SFA, when anterograde method is to risky due to lack of stump in the CFA.

Selected high risk patient with long occlusion in the SFA involving CFA, can be successfully treated in a less invasive way, with the use of various types of devices and techniques, such as atherectomy device, DCB, a dedicated CTO devices, and retrograde or dual access technique.

Disclosure Statement

All authors have nothing to declare.

Author Contributions

Study conception: JL
Writing: NC, TK, MA, JL
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Critical review and revision: all authors
Final approval of the article: all authors
Accountability for all aspects of the work: all authors

References

1) Capek P, McLean GK, Berkowitz HD. Femoropopliteal angioplasty. Factors influencing long-term success. Circulation 1991; **83 Suppl**: I70-80.
2) Rosenfield K, Jaff MR, White CJ, et al.; LEVANT 2 Investigators. Trial of a paclitaxel-coated balloon for femoropopliteal artery disease. N Engl J Med 2015; **373**: 145-53.
3) Charalambous N, Schafer PJ, Trentmann J, et al. Percutaneous intraluminal recanalization of long, chronic superficial femoral and popliteal occlusions using the Frontrunner XP CTO device: a single-center experience. Cardiovasc Intervent Radiol 2010; **33**: 25-33.
4) Soga Y, Iida O, Suzuki K, et al. Initial and 3-year results after subintimal versus intraluminal approach for long femoropopliteal occlusion treated with a self-expandable nitinol stent. J Vasc Surg 2013; **58**: 1547-55.
5) Yilmaz S, Sindel T, Yegin A, et al. Subintimal angioplasty of long superficial femoral artery occlusions. J Vasc Interv Radiol 2003; **14**: 997-1010.
6) Horie K, Inoue N, Tanaka A. Recanalization of a heavily calcified chronic total occlusion in a femoropopliteal artery using a wingman crossing catheter. Ann Vasc Dis 2016; **9**: 130-4.
7) Mossop PJ, Amukotuwa SA, Whitbourn RJ. Controlled blunt microdissection for percutaneous recanalization of lower limb arterial chronic total occlusions: a single center experience. Catheter Cardiovasc Interv 2006; **68**: 304-10.
8) Shetty R, Vivek G, Thakkar A, et al. Safety and efficacy of the frontrunner XP catheter for recanalization of chronic total occlusion of the femoropopliteal arteries. J Invasive Cardiol 2013; **25**: 344-7.
9) Ueshima D, Ashikaga T, Shimura T, et al. Popliteal retrograde approach is effective and safe for superficial femoral artery chronic total occlusion. Ann Vasc Dis 2015; **8**: 220-6.
10) Bonvini RF, Rastan A, Sixt S, et al. Endovascular treatment of common femoral artery disease: medium-term outcomes of 360 consecutive procedures. J Am Coll Cardiol 2011; **58**: 792-8.
11) Stavroulakis K, Bisdas T, Torsello G, et al. Combined directional atherectomy and drug-eluting balloon angioplasty for isolated popliteal artery lesions in patients with peripheral artery disease. J Endovasc Ther 2015; **22**: 847-52.
12) Cioppa A, Stabile E, Popusoi G, et al. Combined treatment of heavy calcified femoro-popliteal lesions using directional atherectomy and a paclitaxel coated balloon: One-year single centre clinical results. Cardiovasc Revasc Med 2012; **13**: 219-23.